	SJPN Trust's Hirasugar Institute of Technology, Nidasoshi. <i>Inculcating Values, Promoting Prosperity</i>	Dept. of CSE Academic Course Plan
	Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956	2023-24 (EVEN)
	Accredited at 'A' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	

INSTITUTE VISION

“To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society”

INSTITUTE MISSION

“To continuously strive for the overall development of students by educating them in a state-of-the-art-infrastructure, by retaining the best practices, faculties and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals”.

DEPARTMENT VISION

“To be a center of excellence in providing education in the field of Computer Science and Engineering to produce technically competent and socially responsible IT professionals”

DEPARTMENT MISSION


“To provide a theoretical foundation in computing with the exposure of latest tools and technologies, IT infrastructure and encourage students for continuous learning to make them competent professionals”

PROGRAM EDUCATIONAL OBJECTIVES (PEO's) :

1. *Pursue a successful career in the field of Computer Science & Engineering utilizing his/her knowledge and contribute to the profession as an excellent employee, or as an entrepreneur.*
2. *Apply the knowledge of mathematics & computer science fundamentals to analyze & formulate the solution to solve real time problems.*
3. *Exhibit the professional and ethical values, communication & teamwork skills, lifelong learning, multidisciplinary approach to address computer engineering and societal issues.*

PROGRAM OUTCOMES (PO's) :

1. **Engineering knowledge:** *Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.*
2. **Problem analysis:** *Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.*
3. **Design/development of solutions:** *Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.*
4. **Conduct investigations of complex problems:** *Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.*
5. **Modern tool usage:** *Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.*
6. **The engineer and society:** *Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.*

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7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.


PROGRAM SPECIFIC OUTCOMES (PSO's) :

PSO1: Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Bigdata Analytics, Machine Learning and Networking.

PSO2: Make use of modern computer tools for creating innovative career paths to be an entrepreneur and desire for higher studies.

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1.	Internet of Things (18CS81)	01
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1.0 Student Help Desk

Sl. No.	Purpose	Contact Person	
		Faculty	Instructor
1	Head of Department ,NBA Criterial Coordinator ,Module Coordinator, NAAC Criteria 2 Coordinator , Computer Center Lab Incharge, VTU/LIC Coordinator Students Mentor	Dr. K. B. Manwade	Mr. A. R. Bhiste
2	Website Coordinator .Feedback Coordinator , NBA Criteria 4 Coordinator, NAAC Criteria 2,3,5 Co-Coordinator, Module Coordinator, Students Mentor	Dr. Mahesh. G. Huddar	Mr. A. K. Badakar
3	Dept. ED Cell Coordinator , NBA Criteria 6 Coordinator, Module Coordinator,, Class Teacher for VII Sem, Microprocessor Lab Incharge, Students Mentor	Prof. N K Honnagoudar	Mr. A. K. Talawar
4	Innovation Club Coordinator, Dept. NBA Coordinator, AICTE/NIRF activity point Coordinator, NBA Criteria7 and 10 Coordinator, NAAC Criteria 4 Coordinator , Research Center Coordinator , Module Coordinator, Project Lab Incharge, Students Mentor	Prof. S. V. Manjaragi	Mr. Suyash Badi
5	EMS/IA Coordinator, Alumni Coordinator , NBA Criteria 3 Coordinator, NAAC Criterian-7 Co-Coordinator, Dept. Time table Coordinator / Meeting Coordinator, Module coordinator ,Students Mentor	Prof. A A Daptardar	Miss. S. B. Vairagi
6	Department Association Coordinator (STAC) ,Dept. T&P coordinator, Technical magazine / Newsletter Professional body Coordinator ,(IEEE/ISTE), NBA Criteria 5 Coordinator , NACC Criteria 1,5 Co-coordinator, Students Mentor	Prof. Prasanna. G. Patil	Miss. S. G. Hugar
7	Project/KSCST Coordinator, NBA Criteria 2 Coordinator, Class Teacher for III Sem A-DIV, Web Programming Lab Incharge, Students Mentor	Prof. S. I. Mane	Miss. S. B. Vairagi
8	NBA Criterion 9 Coordinator, Class Teacher for V Sem Conference / FDP / Workshop, IIIC/Internship Coordinator, Student Registration Coordinator Students Mentor	Prof. M. G. Ganachari	Mr. A. B. Bennoli
9	Final year seminar Coordinator, System Programming Lab Incharge, GATE/Pre-placement Coaching Coordinator, Class Teacher for III Sem B-DIV, Students Mentor	Prof. Sapna Patil	Miss. S. G. Hugar
10	Dept. Library	Mr. A. R. Bhiste	
Institute Level			
12.	Dean Student Welfare Convener	Dr. Mahesh G. Huddar (7411043272)	
13.	Dean Placements and III Cell	Prof. P. V. Patil (9731104059)	
14.	Anti Ragging Convener	Prof. Girish Zulapi (9480213587)	
15.	Anti Squad Convener	Prof. Girish Zulapi (9480213587)	
16.	Internal Complaint Committee Convener	Prof. S. S. Kamte (9008696825)	
17.	Grievance Redressal Convener	Prof. S. S. Tabhaj (9901398134)	
18.	Sports & Cultural/Extra-Curricular Activities Convener	Sri. S.B. Sarawadi (9739109383)	

2.0 Departmental Resources

Department of Computer Science and Engineering was established in the year 1996 and is housed in a total area of 1206 Sq. Mtrs.

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2.1 Faculty Position

Sl.No.	Category	No. in Position	Average experience (in years)
1.	Teaching Faculty	09	12.5
2.	Technical Supporting Staff	06	15
3.	Helper Staff	03	19

2.2 Major Laboratories

Sl.No.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested (Rs. in Lakhs)
1.	System Programming Lab.	70	12.65
2.	C Programming Lab/ Algorithms/ Network Lab.	70	19.34
3.	Project Laboratory	70	20.06
4.	Microprocessors Lab.	70	22.14
5.	Web Programming/DBA Lab.	70	09.56
6.	Computer Center	220	234.79

Total Investment in the Department

Rs. 318.54 Lakhs

3.0 Teaching Faculty Details

Sl. No.	Name	Designation	Qualification	Specialization	Professional Membership	Teaching Exp (in yrs)	Phone No.
1	Dr. K. B. Manwade	Assoc. Prof	M. Tech, Ph.D	CSE	LMISTE,CSI	17.06	8412968254
2	Dr. Mahesh. G. Huddar	Assoc. Prof	M. Tech, Ph.D	CSE	LMISTE	13.00	7411043272
3	Prof. N K Honnagoudar	Asst. Prof.	M.E	ECE	LMISTE	19.06	9449495302
4	Prof. S. V. Manjaragi	Asst. Prof.	M.Tech.(Ph.D)	CSE	LMISTE	18.06	9986658309
5	Prof. A A Daptardar	Asst. Prof	M. Tech.	CSE	LMISTE	15.06	9620851002
6	Prof. Prasanna. G. Patil	Asst. Prof	M. Tech	CSE	LMISTE,CSI,IE	09.1	9743202717
7	Prof. S. I. Mane	Asst. Prof	M. Tech	CNE	--	8.00	9743202717
8	Prof. M. G. Ganachari	Asst. Prof	M. Tech	IE	-	12.00	8904879471
9	Prof. Sapna Patil	Asst. Prof	M. Tech	DE	--	1.00	9740875627



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Dept. of CSE

Academic

Course Plan

2023-24 (EVEN)


4.0

Institute Academic Calendar

ACADEMIC CALENDAR OF EVENTS-01 (CoE-01) OF VIII & II SEMs FOR THE AY: 2023-24


Ref: 1) VTU CoE Draft Notification No.: VTU/BGM/AC/2023-24/5699, Dated 16th June 2024
2) VTU CoE Notification No.: VTU/BOS/AC2023-24 (EVEN)/6251, Dated 12th Feb. 2024

Calendar							Date	Events & Holidays																																																	
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	SJPN Trust's Hirasugar Institute of Technology, Nidasoshi. <i>Inculcating Values, Promoting Prosperity</i>	Dept. of CSE
	Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956	Academic
	Accredited at 'A' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	Course Plan
		2023-24 (EVEN)

5.0 Scheme of Teaching & Examination

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI Scheme of Teaching and Examination 2018 – 19 Choice Based Credit system (CBCS) AND Outcome Based Education (OBE) (Effective from the academic year 2018 – 19)												
VIII SEMESTER												
Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18CS81	Internet of Things	CS / IS	3	--	--	03	40	60	100	3
2	PEC	18CS82X	Professional Elective – 4	CS / IS	3	--	--	03	40	60	100	3
3	Project	18CSP83	Project Work Phase – 2	CS / IS	--	--	2	03	40	60	100	8
4	Seminar	18CSS84	Technical Seminar	CS / IS	--	--	2	03	100	--	100	1
5	INT	18CSI85	Internship	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)			03	40	60	100	3	
TOTAL					06	--	04	15	260	240	500	18
Note: PCC: Professional Core, PEC: Professional Elective, OEC: Open Elective, INT: Internship.												
Professional Electives – 4												
Course code under 18CS82X		Course Title										
18CS821		Mobile Computing										
18CS822		Storage Area Networks										
18CS823		NoSQL Database										
18CS824		Multicore Architecture and Programming										
Project Work CIE procedure for Project Work Phase - 2: (i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates. (ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates. SEE for Project Work Phase - 2: (i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department. (ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to. Internship: Those, who have not pursued /completed the internship shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements												
AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card. Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).												

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	Hirasugar Institute of Technology, Nidasoshi.		Academic
	<i>Inculcating Values, Promoting Prosperity</i>		Course Plan
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Subject Title	INTERNET OF THINGS		
Subject Code	18CS81	IA Marks	40
Number of Lecture Hrs/ Week	03:0:0 L	Exam Marks	60
Total Number of Lecture Hrs	40	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Prof. M. G. Ganachari	Designation: Asst. Prof.	Experience: 13 Years
No. of times course taught: 04		Specialization: Industrial Electronics

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Computer Science and Engineering	V	Computer Networks
02	Computer Science and Engineering	IV	Data Communication & Networking.

2.0 Course Objectives


Students should learn to:

- Assess the genesis and impact of IoT applications, architectures in real world.
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT.
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

3.0 Course Outcomes

After studying this course, students will be able to

	Course Outcome	Cognitive Level	POs/PSOs
C415.1	Assess the genesis and impact of IoT applications, architectures in real world.	L2	PO1,PO2,PO3,,PO8,PO12 PSO1,PSO2
C415.2	Illustrate diverse methods of deploying smart objects and connect them to network.	L2	PO1,PO2,PO3,PO4,PO8,PO12 PSO1,PSO2
C415.3	Compare different Application protocols for IoT.	L2	PO1,PO2,PO3,,PO8,PO12 PSO1,PSO2
C415.4	Infer the role of Data Analytics and Security in IoT.	L2	PO1,PO2,PO3,PO8,PO12 PSO1,PSO2
C415.5	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.	L2	PO1,PO2,PO3,,PO8,PO12 PSO1,PSO2
Total Hours of instruction		50	

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	Accredited at 'A' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE		2023-24 (Even)

4.0 Course Content

Module – 1

08 Hours

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack. RBT : L1,L2,L3.

Module – 2

08 Hours

Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. RBT : L1,L2,L3.

Module – 3

08 Hours

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods. RBT : L1,L2,L3.

Module – 4

08 Hours

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment. RBT : L1,L2,L3.

Module – 5

08 Hours

IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture. Smart city security architecture, smart city use case Examples. RBT : L1,L2,L3.

5.0 Relevance to future subjects


Sl. No.	Semester	Subject	Topics
01	VIII	Academic Project	IoT based Projects installation and Big Data Analytics Concepts

6.0 Relevance to Real World

Sl.No.	Real World Mapping
01	Final year projects on analytics

7.0 Gap Analysis and Mitigation

Sl. No.	Delivery Type	Details
01	YouTube / NPTEL Videos	Hadoop Tutorials
02	YouTube / NPTEL Videos	Data Analytics Tutorials

	S J P N Trust's	Hirasugar Institute of Technology, Nidasoshi.	Dept. of CSE
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	Accredited at 'A' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE		2023-24 (Even)

8.0 Books Used and Recommended to Students

Text Books
<ol style="list-style-type: none"> David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 9789386873743) Srinivasa K G, "Internet of Things", CENGAGE Learning India, 2017
Reference Books
<ol style="list-style-type: none"> Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547) Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)
Additional Study material & e-Books
<ol style="list-style-type: none"> Big Data Analytics by Parag Kulkarni, Sarang Joshi, Meta S. Brown

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
<ol style="list-style-type: none"> https://www.tutorialspoint.com/big_data_analytics/ https://www.tutorialride.com/big-data-analytics/big-data-analytics-tutorial.htm

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IoT, ISSN: 2058-6345	https://link.springer.com/journal/41044
2	Big Data Research, ISSN: 2214-5796	https://www.journals.elsevier.com/big-data-research

11.0 Examination Note

Internal Assessment: 40 Marks, External Theory : 60 Marks

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

12.0 Course Delivery Plan


Module	Lecture No.	Content of Lecturer	% of Portion
1	1	What is IoT, Genesis of IoT	20
	2	IoT and Digitization, IoT Impact	
	3	Convergence of IT and IoT, IoT Challenges	
	4	IoT Network Architecture and Design	
	5	Drivers Behind New Network Architectures	
	6	Comparing IoT Architectures	
	7	A Simplified IoT Architecture, The Core IoT Functional Stack	
	8	IoT Data Management, Compute Stack.	



2	9	Smart Objects	20
	10	The "Things" in IoT, Sensors	
	11	Actuators	
	12	Smart Objects	
	13	Sensor Networks	
	14	Connecting Smart Objects	
	15	Communications Criteria	
	16	IoT Access Technologies.	
3	17	IP as the IoT Network Layer	20
	18	The Business Case for IP	
	19	The need for Optimization	
	20	Optimizing IP for IoT	
	21	Profiles and Compliances	
	22	Application Protocols for IoT	
	23	Transport Layer,	
	24	IoT Application Transport Methods	
4	25	Data and Analytics for IoT	20
	26	An Introduction to Data Analytics for IoT	
	27	Machine Learning	
	28	Big Data Analytics Tools and Technology	
	29	Edge Streaming Analytics	
	30	Network Analytics, Securing IoT	
	31	A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices	
	32	Systems Vary, Formal Risk Analysis Structures, OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.	
5	33	IoT Physical Devices and Endpoints	20
	34	Arduino UNO: Introduction to Arduino	
	35	Arduino UNO, Installing the Software	
	36	Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints	
	37	RaspberryPi: Introduction to RaspberryPi	
	38	About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python	
	39	Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH	
	40	Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Module 1	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Printed solution expected.	Book 1

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2	Assignment 2: University Questions on Module 2	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Printed expected.	Activity. solution	Book 1
3	Assignment 3: University Questions on Module 3	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	6	Individual Printed expected.	Activity. solution	Book 1
4	Assignment 4: University Questions on Module 4	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Printed expected.	Activity. solution	Book 1
5	Assignment 5: University Questions on Module 5	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	10	Individual Printed expected.	Activity. solution	Book 2

14.0 QUESTION BANK

MODULE – 1


- Briefly explain about IOT?(Jan2019)
- Explain about IOT and Digitization.(Sept2021)
- Explain about IOT network architecture.(Jan2019)
- Comparing IOT architecture.(Jan2018)
- Explain about IOT data management system.(Sept2020/21)
- Explain about IOT impact in real time applications.(Sept2018)
- Explain about convergence of IT and OT.(Sept2021)
- Briefly explain about IOT challenges.(Sept2019/20)
- Explain about IOT world Forum standardized Architecture.(Sept2018)
- Explain about core IOT functional stack.(Jan2020)
- Explain about network topology.(Sept2019)

MODULE – 2

- Explain about the smart objects..(Sept2020)
- Explain about things in IOT sensor..(Sept2021)
- Explain about actuators..(Sept2020)
- What are the methods are used to connecting smart objects.(Jan2020)
- Explain about IOT access technology..(Sept2020)
- Explain about Micro Electro mechanical system(MEMS).(Sept2021)
- Explain about wireless sensor networks(WSNS).(Sept2019)
- Explain about IOT Access Technology.(Sept2021)
- Explain about Zigbee architecture.(Jan2019)
- Explain IEEE 802.15.4 MAC format.
- Explain the structure of LoRa WAN layers.(Aug2020)

MODULE – 3

- Explain about IP and IOT network layer.(Sept2019)
- Explain about need for optimization.
- Explain about optimization of IP over IOT.(Sept2021)
- Explain about Profiles and compliances.(Sept2019)

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5. Mention the applications of IOT..(Sept2021/Jant2021)
6. Mention the key advantages of internet protocol.(Sept2019)
7. With suitable diagram explain about header compression..(Sept2019)
8. Explain about 6TiSCH.(Jan2020)
9. Explain about RPL.(Sept2020)
10. Explain about SCADA.(Sept2020)
11. Explain about application Layer protocols.(Sept2020)
12. Explain about with suitable block diagram MQTT.(Sept2021)

MODULE – 4





1. Explain about data analytics in IOT..(Jan2019)
2. What is machine learning?.(Jant2019)
3. Explain about big data analytics and tools..(Jan2018)
4. What is edge streaming analytics?(Sept2021)
5. Explain about common challenges in OT security..(Jan2019)
6. Explain about formal risk analysis structures..(Sept2019)
7. Explain about structured verses unstructured data..(Sept2021)
8. Explain about machine learning.(Jan2020)
9. Explain about NoSQL data bases.(Sept2021)
10. Explain about hadoop tool methods.(Sept2019)
11. Explain about Lambda Architecture.(Sept2021)
12. Compare big data and Edge analytics.(Sept2021)


MODULE – 5

1. Explain about IOT physical devices and end points.(Aug2021)
2. Explain about Arduino installingsoftware..(Sept2018)
3. Explain about Raspberry pi.(Sept2021)
4. Explain the programming in Raspberry pi and python.(Sept2021)
5. Explain about smart and connected cities.(Aug2020)

15.0 University Result

Examination	S+	S	A	B	C	D	E	Fail	% Passing
JUL-2022	FCD			FC	SC			Fail	100
	21			18	04			00	
JUL-2023									

Prepared by	Checked by		
			
Prof. M. G. Ganachari	Prof. N. K. Honnagoudar	HOD	Principal

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Subject Title	STORAGE AREA NETWORK		
Subject Code	18CS822	IA Marks	40
Number of Lecture Hrs / Week	03	Exam Marks	60
Total Number of Lecture Hrs	40	Exam Hours	03
Credits-03			

FACULTY DETAILS:		
Name: Prof. S. I. Mane	Designation: Asst. Professor	Experience: 09 years
No. of times course taught: 2 (including present)		Specialization: Computer Networks Engg.

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Computer Science and Engineering	4	Data communication
02	Computer Science and Engineering	5	Computer Networks
03	Computer Science and Engineering	3	Computer Organization


2.0 Course Objectives

1. Evaluate storage architectures.
2. Define backup, recovery, disaster recovery, business continuity, and replication.
3. Examine emerging technologies including IP-SAN.
4. Understand logical and physical components of a storage infrastructure.
5. Identify components of managing and monitoring the data center.
6. Define information security and identify different storage virtualization technologies

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

COs	Course Outcome	Cognitive Level	POs
C411.1	Identify key challenges in managing information and analyze different storage networking technologies and virtualization.	L2	1,2,3,10,11,12
C411.2	Explain components and the implementation Network-Attached Storage NAS .	L2	1,2,3,10,11,12
C411.3	Describe CAS architecture and types of archives and forms of virtualization.	L2	1,2,3,10,11,12
C411.4	Illustrate the storage infrastructure and management activities.	L2	1,2,3,10,11,12
Total Hours of instruction			40

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4.0 Course Content

Module – 1 8 Hours

Storage System: Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. **Data Center Environment:** Application Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application.

Module – 2 8 Hours

Data Protection - RAID : RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison. **Intelligent Storage Systems :** Components of an Intelligent Storage System, Types of Intelligent Storage Systems. **Fibre Channel Storage Area Networks - Fibre Channel:** Overview, The SAN and Its Evolution, Components of FC SAN.

Module – 3 8 Hours

IP SAN and FCoE: iSCSI, FCIP, **Network-Attached Storage:** General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance

Module – 4 8 Hours

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions, **Backup and Archive:** Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments

Module – 5 8 Hours

Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas. **Remote Replication:** Modes of Remote Replication, Remote Replication Technologies. **Securing the Storage Infrastructure:** Information Security Framework, Risk Triad, Storage Security Domains. Security Implementations in Storage Networking

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
1	8	Project work	Project on Networking


6.0 Relevance to Real World

SL.No	Real World Mapping
01	Provide solution for Storage related problems.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	NPTEL	Storage Systems

8.0 Books Used and Recommended to Students

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			Academic
			Course Plan
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Text Books
1. Information Storage and Management, Author :EMC Education Services, Publisher:Wiley ISBN: 9781118094839
Reference Books
1. Paul Massiglia, Richard Barker, "Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs Paperback", 1st Edition, Wiley India Publications, 2008
Additional Study material & e-Books
http://rsmt.it.fmi.uni-sofia.bg/HPstorage/Storage%20Networks%20Explained%202nd%20Edition.pdf

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
https://www.youtube.com/watch?v=KXQUJWTrIA
https://www.youtube.com/watch?v=k19X6mzEWO4

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	IEEE	https://ieeexplore.ieee.org/document/6419516/

11.0 Examination Note

Internal Assessment: 30+10=40 Marks

30 marks –from three internal assessment test

10 marks- from the assignments

Scheme of Evaluation for Internal Assessment (30 Marks)

- Internal Assessment test in the same pattern as that of the main examination Average of all three tests: 30 marks.
- Assignment marks for each module is 25. Average of 5 assignment marks will be taken and finally scale down to 10 marks.

Question Paper Pattern (IA):

- Four main questions to be set from syllabus covered up to IA tests.
- Student has to answer two full main questions selecting Q.No.1 OR Q.No.2 and Q.No.3 OR Q.No.4 each question carries 15 marks, Total test marks are 30.
- The average marks scored is average of all three tests.

Question Paper Pattern and instructions (Main Exam):

- The question paper will have TEN questions.
- There will be TWO questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Max. Marks: 100 and each question carries 20 marks.

Exam Duration: 3 Hrs.

12.0 Course Delivery Plan


Module	Lecture No.	Content of Lecturer	% of Portion
1	1	Introduction to Information Storage: Information Storage	20 %
	2	Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing	
	3	Data Center Environment: Application Database Management System	
	4	Host (Compute),	
	5	Connectivity, Storage	
	6	Disk Drive Components, Disk Drive Performance	



	7	Host Access to Data, Direct-Attached Storage	
	8	Storage Design Based on Application.	
2	9	Data Protection - RAID : RAID Implementation Methods, RAID Array Components	20 %
	10	RAID Techniques	
	11	RAID Levels	
	12	RAID Impact on Disk Performance, RAID Comparison..	
	13	Intelligent Storage Systems : Components of an Intelligent Storage System,	
	14	Types of Intelligent Storage Systems. Fibre Channel Storage Area Networks - Fibre Channel: Overview	
	15	The SAN and Its Evolution	
	16	Components of FC SAN	
3	17	IP SAN and FCoE : iSCSI	20 %
	18	FCIP	
	19	Network-Attached Storage: General-Purpose Servers versus NAS Devices	
	20	Benefits of NAS, File Systems and Network File Sharing	
	21	Components of NAS, NAS I/O Operation	
	22	NAS Implementations	
	23	NAS File-Sharing Protocols	
	24	Factors Affecting NAS Performance	
4	25	Introduction to Business Continuity : Information Availability, BC Terminology	20 %
	26	BC Planning Life Cycle	
	27	Failure Analysis, Business Impact Analysis	
	28	BC Technology Solutions	
	29	Backup and Archive: Backup Purpose, Backup Considerations	
	30	Backup Granularity, Recovery Considerations	
	31	Backup Methods, Backup Architecture, Backup and Restore Operations	
	32	Backup Topologies, Backup in NAS Environments	
5	33	Local Replication : Replication Terminology, Uses of Local Replicas	20 %
	34	Replica Consistency , Local Replication Technologies	
	35	Tracking Changes to Source and Replica, Restore and Restart Considerations	
	36	Creating Multiple Replicas	
	37	Remote Replication: Modes of Remote Replication	
	38	Remote Replication Technologies.	
	39	Securing the Storage Infrastructure: Information Security Framework, Risk Triad	
	40	Storage Security Domains. Security Implementations in Storage Networking	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 1, of the syllabus	3	Individual Activity.	Text book-1
2	Assignment 2: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 2 of the syllabus	6	Individual Activity.	Text book-1
3	Assignment 3: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 3, of the syllabus	8	Individual Activity.	Text book-1

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4	Assignment 4: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 4 of the syllabus	10	Individual Activity.	Text book-1
5	Assignment 5: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 5 of the syllabus	12	Individual Activity.	Text book-1

14.0

QUESTION BANK

MODULE 1


1. Explain the architecture and evolution of storage technology with diagram?(Jan 21, July 22)
2. Explain disk drive components, with suitable diagram. (10 Marks July 22)
3. List down the logical components of the hosts. Explain in detail regarding 1) volume manager 2) File system
4. Explain key characteristics of datacenter with neat diagram.(08 Marks Jan 21)
5. Discuss the function of logical volume manager with neat diagram.
6. Explain the concept of computer virtualization along with its advantages with neat diagram.
7. What is a file system? Explain the process of mapping user files to the disk storage. (08 Marks Jan-19)
8. Explain core elements of data center along with key characteristics.(08 Marks Jan 19, 10 Marks July 22)
9. Discuss process of host access to storage.(06 Marks July 22)
10. Discuss concept of DAS with its advantages and disadvantages. (06 Marks July 22)
11. Explain disk partitioning and concatenation.(04 Marks July 22)

MODULE 2

1. Describe RAID levels with reference to nested RAID, RAID 3 and RAID5, with neat diagram.(10 Marks July 22)
2. Explain the components of ISS with reference to LUN and LUN masking with diagram.
3. Discuss intelligent storage array, in detail.
4. Explain the below concepts briefly with appropriate diagram. 1) RAID 0 2) RAID 1 3) Parity 4) Hot Spares.
5. What is intelligent storage system? With neat diagram explain the components of an intelligent storage system.(04 Marks July 22)
6. Explain the features of RAID 6 with a diagram.
7. discuss the features of high end storage system with neat diagram
8. An application has 1,000 heavy users at a peak of 2 IOPS each and 2,000 typical users at a peak of 1 IOPS each, with a read/write ratio of 2:1. It is estimated that the application also experiences an overhead of 20 percent for other workloads. Calculate the IOPS requirement for RAID 1, RAID 3, RAID 5, and RAID 6. compute the number of drives required to support the application in different RAID environments if 10K RPM drives with a rating of 130 IOPS per drive were used.
9. Categories and explain intelligent storage systems with diagram.
10. What is RAID? Explain the RAID levels with reference to nested RAID, RAID3, RAIDS with neat diagram. (08 Marks Jan-19)
11. With neat diagram, explain the structure of read and write operations with cache. (08 Marks Jan-19, July 22)
12. What is SAN? List and briefly explain the various fibre channel ports.
13. Explain the concept of zoning along with the types of zoning. (08 Marks Jan 21)
14. Explain the connectivity options of FC architecture with relevant diagrams.
15. Discuss different layers of Fiber Channel protocol stack with neat diagram. (08 Marks Jan 21)
16. Discuss the different types of FC ports with neat diagram.
17. Discuss RAID impact on disk performance.(04 Marks July 22)
18. List and Explain RAID techniques. (06 Marks July 22)

MODULE 3

1. What is NAS? What are the benefits of NAS ? List down the factors affecting NAS performance and availability. (08 Marks Jan 21)
2. What is iSCSI ? Explain iSCSI protocol stack with neat block diagram.(08 Marks July 22)

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3. Explain the components of NAS with neat diagram. What are the benefits of NAS ?(08 Marks July 22)
4. Describe the NAS gateway connectivity with neat diagram
5. Write a short note on CIFS.
6. Draw and explain the components, the topologies and the protocol stack of iSCSI.
7. Explain object storage and retrieval in CAS, with suitable diagrams.
8. Describe storage virtualization types in detail and discuss its challenges.
9. Explain the concept of CAS with its architecture.
10. Write short note on 1) Network virtualization. 2) Server virtualization.
11. With neat diagram, explain the storage virtualization concept.
12. Explain the architecture of CAS with a neat diagram. List out the features of CAS.
13. Define storage virtualization? What are the forms of storage virtualization
14. Explain block level virtualization, with neat diagram
15. Explain the data object storage process and process of data retrieval from CAS system with diagram.
16. Illustrate a NAS environment before and after the implementation of file level virtualization.
17. Explain FC connectivity options with relevant diagram. (08 Marks Jan-19)
18. Explain block-level storage virtualization with neat diagram. Explain VSAN in brief. (08 Marks Jan-19)
19. What is FCoE? Explain the components of FCoE with neat diagram. (08 Marks Jan-19)
20. What is NAS? Explain the benefits of NAS. (08 Marks Jan-19)
21. Compare CIFS and NFS protocols.(04 Marks July 22)
22. Explain fiber Channel Protocol stack with diagram.(08 Marks July 22)

MODULE 4

1. Describe failure analysis in BC. Mention some more important BC technology solution.(10 Marks July 22)
2. Explain back up topologies in detail
3. Explain Business continuity (BC) life cycle in detail.(10 Marks July 22)
4. Explain any two basic back up topologies that are used in a back up environment with a neat diagram.
5. Define the following terminologies 1)MTBF 2)RPO 3)MTTR 4)RTO 5)disaster recovery
6. Explain the backup operation with neat diagram
7. What are different back up topologies? Explain. (08 Marks Jan 21)
8. What is business continuity? Explain the BC Terminology in detail. (08 Marks Jan-19)
9. Explain Backup and Restore operations with neat diagram. (08 Marks Jan-19 , 10 Marks July 22)
10. What is data deduplication? Explain the implementation of data duplication. (08 Marks Jan-19/21)

MODULE 5





1. Explain local replication technologies, in detail . Explain network based replication technology. (10 Marks July 22)
2. Explain the various remote replication modes.
3. Explain the concept of, 1) LVM based replication. 2) Full Volume mirroring 3) Uses of local replicas.
4. What is remote replication? Explain the concept of synchronous replication and asynchronous replication.
5. Explain LVM based local replication with a neat diagram. Discuss the advantages and disadvantages
6. Explain the synchronous and asynchronous modes of remote replication with neat diagram 10 marks
7. What is the importance of recoverability and consistency in local replication?
8. Discuss the effects of a bunker failure in a three-site replication for the following implementation:
 1. Multihop—synchronous + disk buffered
 2. Multihop—synchronous + asynchronous
 - 3 Multi-target.
9. Explain Synchronous + Asynchronous and Synchronous + Disk Buffered methods of three-site replication with neat diagram. (08 Marks Jan-19)
10. Explain the security attributes of storage security frame works.
11. Describe SAN security architecture with diagram.
12. Describe storage management activities in detail, with example.
13. Briefly explain the SAN security architecture, illustrating the various levels(zones of storage environment) that must be secured.
14. List out and explain briefly the parameters to be monitored in the storage infrastructure components ? Explain accessibility monitoring with a neat diagram.
15. Write a note on risk TRIAD.
16. Explain the concept of Kerberos with neat diagram.
17. What are monitoring parameters and components monitored for storage infrastructure? Explain in details.

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18. Explain storage infrastructure management activities in detail.
19. Explain CHAP protocol?
20. With neat diagram explain network layer firewalls?
21. Explain FC SAN security architecture with neat diagram. (08 Marks Jan-19)
22. Explain the concept of Kerberos with neat diagram. (08 Marks Jan-19)
23. Explain the storage management activities in detail. (08 Marks Jan-19)

15.0 University Result

Examination	FCD	FC	SC	% of Passing
June-2023	21	16	14	100

Prepared by	Checked by		
			
Prof. S. I. Mane	Prof. S. V. Manjaragi	HOD	Principal